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USSR Report

PHYSICS AND MATHEMATICS

No. 60

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12 March 1980

USSR REPORT

PHYSICS AND MATHEMATICS

No. 60

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HOLOGRAPHY ADVANCES NOTED

Moscow IZVESTIYA in Russian 9 Dec 79 p 3

[Article by S. Davitaya, IZVESTIYA correspondent, Tbilisi: "A Window Looking Into the Future"]

[Text] In recent years unusual pictures -- holograms -- have appeared at dozens of scientific centers throughout the world and at various international exhibits. I am looking at one: old-fashioned silver adornments -- beads, artfully crafted Georgian chased bracelets. The picture is so three-dimensional and realistic that one involuntarily extends one's hand to grasp the real thing, but it strikes an invisible obstacle -- the surface of a plate. The objects appear to be positioned deeper, as if behind the glass of a museum display case, and yet in actual fact the picture is absolutely plane, and the chased adornments, in all the perfection of their skilled craftsmanship, are merely an apparition, a mirage, which carries, however, important information on the original.

But much more distinguishes the hologram from the ordinary photograph. A photograph or drawing gives an idea about certain external features of an object, but the image obtained is not alive. A hologram, however, of a mirror, for example, will reflect just as an actual mirror, everything you place before it. A hologram of a lens will reproduce the principal properties of the lens. This occurs because a holographic record of the light waves reflected by an object contains complete information on these waves, that is, about the object itself (the Greek word holography means "complete record"). In addition, on one and the same photographic plate, by merely changing the angle of its illumination, one can record an infinite number of holograms, and each of these can be read if one directs onto the plate a laser beam at the same angle at which the recording was made. This is an extremely economical method of storing information, is it not?

Where else in nature have we encountered such capacity? Perhaps only in the functioning of the human brain. One is drawn to continue the analogy. Does not the amazing flexibility and reliability of the brain, the cells of which are capable of taking over the functions of cells which have become disabled, of replacing them in large measure, have something in common with the no less amazing property of holograms to store at each point information on the entire object?

Customarily a hologram is justifiably compared with a window open to the world. Regardless of the angle of view we select -- leaning against the left or right side of the window frame, resting our chin on the windowsill or climbing up on it -- the view from the window will remain essentially the same. It is merely that we, changing our point of viewing, will see some things in greater detail, while others will disappear from view.

About 20 years ago Corresponding Member of the USSR Academy of Sciences Yu. Denisyuk, head of the Soviet school of holography and a Lenin Prize recipient, developed a method of so-called reflecting holography in a three-dimensional medium, which enables one, in addition to the volume of an object, to record its color as well. In other words this scientist succeeded in putting to harness wavelength, which determines sensation of color, and amplitude -- luminosity and phase -- which roughly speaking reflects the distance of an object -- three light characteristics. There remained polarization, but polarization is invisible to the human eye....

A team of young physicists at the Georgian SSR Academy of Sciences Institute of Cybernetics, under the direction of Shermazan Dmitriyevich Kakichashvili, began their pioneer work in holography in 1964.

...In the soft reddish light of a special reflector, behind a circular transparent shell (as if in the center of a cylinder) -- can you beat that? -- the living head of the laboratory director, right down to the finest details. One's groping hand, lowered into the cylinder, grasps emptiness, but the head is there in plain sight.... One can turn the head to the right, to the left, and turn the back of the head forward. A rather eery impression.... "Isn't it a little frightening to see your own head there, detached from your body?" I asked Kakichashvili. "No," he laughs. "It is even interesting to recall how young I was 7 years ago."

Of course this hologram was made by no means for amusement. For the first time in history a living object was recorded on a circular hologram, with a ruby pulsed laser built in this laboratory. Development of the circular hologram created the possibility of turning to one's hearts content not the live object itself but its "ghost," which carries, however, complete visual information on it.

Judge for yourselves how attractive such a capability would be to the biologist, physician, and... physicist, who would be able to "catch" the elusive motion of elementary particles in bubble chambers and Wilson cloud chambers. A vast expanse of problems, one more fascinating than the other, had opened up before the young team of scientists. In 1969 they took the first holographic film, only 200 frames in length, but perhaps this film was fated to become a stepping-stone to the art of the future.

Understandably a step from a holographic picture to holographic motion pictures is inevitable, just as the following step -- to holographic television.

You will recall that we mentioned that three basic characteristics of a light wave are utilized in holography to create a visual image -- wavelength, amplitude, and phase. We omitted the fourth and final dimension -- polarization -- because it is not perceived by the human eye and therefore does not directly influence the visual image. But the property of polarization is widely employed in modern science -- crystal physics, ellipsometry, and polarimetry. On the basis of direction and shape of oscillations of light waves, investigators determine the structure of a substance and processes invisible to the eye.

The idea of a truly complete (including polarization) record of information by holographic means became the principal motivation for Sh. Kakichashvili in 1966. A theory was born, but "its results were so strange, literally discouraging at the scientific level," the scientist related, "that we refrained from publishing our results. For some time we all became transformed into chemists, in order to obtain optimal materials for recording polarization. Incidentally, even now we are apparently the only producers of these media. By 1971 numerous experiments with various materials confirmed the correctness of our theory, and on 10 May of this year the USSR State Committee for Inventions and Discoveries registered our discovery: "Phenomenon of Reproduction of the Wave Pattern of an Electromagnetic Field."

Thus polarization holography was born. What new things does it offer? First of all man obtains a reliable method of recording and storing information, involving polarization. In addition, he acquires a new tool for scientific research in all areas where light is utilized. With the aid of polarization, for example, the structures of living tissues at the cell level are investigated in biochemistry and biophysics, the strength of structures in mechanics, while absorption of light in the interstellar medium is studied in astrophysics.

The Tbilisi physicists, under Kakichashvili's direction, are elaborating a theory according to which certain changes in the polarization pattern of a holographic image (in comparison with testing) enable one to determine the shape of molecules. But this is only a first step into the alluring depths....

Dennis Gabor, the founder of holography, once said: "Everything has its end, but the end to applications of holography is not in sight...." We must agree with him, especially when one realizes that everything we have mentioned up to the present time is only a small part of the possibilities of holography connected with recording light waves. A "complete record" of information on an object can theoretically be obtained with the aid of radio waves, sound, as well as infrared or X-rays. The limiting factor lies only in the technical recording capabilities. The Tbilisi physicists are working successfully with ultrasound.

The property of ultrasound to alter the velocity of its propagation in relation to the density of the medium through which it passes is widely utilized today both in medicine, where organs and tissues are "probed" with its assistance, and in various branches of industry, where ultrasonic flaw detectors are employed. What is inside it? a person inquires. His reply is a pattern on an oscillograph. A signal indicating a cavity in the body of a turbine or aircraft, or a thickening in human tissues is of course a result of no small significance. But you will agree that for a doctor or designer it is a very attractive prospect to see with one's own eyes the shape, position and all kinds of parameters of that internal defect on which his attention is focused. This can be achieved with the aid of holography.

Water is presently playing the major role in experiments being performed by the Tbilisi physicists. There is an ultrasound source at the bottom of a small pool. Let us say that there is an egg in the path of the emitted waves. Penetrating it, the ultrasonic waves form on the water surface an intricate pattern which contains all information on the internal structure of the egg. A laser beam "reads" this information from the water surface. Three-dimensional filters are placed on its path to a photographic plate, which enable investigators to specify a different depth for a future image and to obtain on a hologram slices of the object, as it were. But they are of the opinion that water is not ideal. A water surface can be successfully replaced by a polymer film. Several types, which magnify image brightness 10-fold, have already been developed.

As a conclusion one generally presents the reader with a picture of the near or distant future. I should like to imagine a medical consultation taking place in a small circular office or auditorium, the walls of which constitute a circular screen. The subject of discussion is the stomach of patient X. and everything which is taking place in it. The exchange of opinions is distinguished by particular concreteness and exactness, because the subject of discussion -- that specific stomach -- is depicted with all its walls in an image surrounding the consultation group, an image obtained from a circular hologram.

Such a medical consultation could take place in the future. I was shown a miniature instrument for taking holograms of cavity internal organs at an optical research laboratory. And this means that how soon the imagined picture from the future becomes a reality of today depends not so much on the scientists as on many others, perhaps including you and me.
[82-3024]

3024
CSO: 1862

USSR UDC 534,87

CERTAIN FEATURES OF THE CORRELATION OF PSEUDONOISE SIGNALS REFLECTED FROM A STRATIFIED OCEAN BOTTOM

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 25, No 6, 1979 pp 854-859
manuscript received 11 Mar 79

VOLOVOV, V. I., KRASNOBOROD'KO, V. V. and LYSANOV, YU. P., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] Analysis of experimental data obtained from the deep-water ocean regions has shown that the cross-correlation between the noise signal reflected from the ocean bottom and the emitted signal is characterized by several peaks due to the stratified structure of the ocean bottom in these regions, with each peak due to reflection from a different layer boundary. In this connection certain features of the cross-correlation of pseudonoise signals reflected from an underwater bottom consisting of N layers with statistically uneven boundaries are analyzed. A formula for determining the coefficients of reflection from different layer boundaries on the basis of measurements of some one reflection coefficient (e.g. for the water-ground boundary) by some autonomous method is presented. The calculations show satisfactory agreement with experiment. Figures 4; references 9: 7 Russian, 2 Western.
[81-1386]

USSR UDC 534.222

DETERMINATION OF THE ACOUSTIC INHOMOGENEITY OF A MEDIUM BY MEANS OF SONIC SIGNALS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 25, No 6, 1979 pp 860-867
manuscript received 19 Dec 78; after editing, 22 May 79

VORONOVICH, A. G. and MAL'TSEV, N. YE., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] Sonic waves propagating in inhomogeneous media undergo scattering. This raises the question of whether it is possible to derive the parameters of an inhomogeneity from the values characterizing the passage of acoustic signals across it. In this connection the one-dimensional idealized problem of a half-space in which the speed of sound depends on a single spatial coordinate z, and which is bounded by a rigid plane when $z = 0$, is considered, on assuming that at the instant $t = 0$ that plane undergoes the instantaneous displacement A_0 along the normal. Specifically,

the speed of sound is determined as a function of the spatial coordinate c(z). The problem is solved in the one-dimensional case by reducing it to the converse problem of the quantum theory of scattering. It is shown that in the presence of weak inhomogeneities the c(z) profile can be reconstructed over the scattered field computed in the Born approximation. Corresponding calculations also are performed for a point source in a real geophysical situation--the profile of the speed of sound in the ocean is determined according to the scatter of the field of a point source. References: 5 Russian.
[81-1386]

USSR UDC 534.8

ULTRASONIC METHOD FOR INVESTIGATING HYDRODYNAMICAL CAVITATION IN A VISCOUS FLUID

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 25, No 6, 1979 pp 868-874
manuscript received 18 Sep 78; after editing, 15 Mar 79

GLINSKIY, V. A., KOL'TSOVA, I. S., MIKHAYLOV, I. G. and POKROVSKAYA, I. YE.,
Physics Department, Leningrad State University imeni A. A. Shdanov;
Scientific Research Physics Institute

[Abstract] A method for ultrasonic probing of the cavitational plume generated by the flow of a viscous fluid through an aperture (throttle) in a thin wall into a variable-pressure chamber is proposed. The method is based on the principle of the additional attenuation of ultrasonic waves by gas bubbles. It is shown that probing by means of a high-frequency ultrasonic beam serves to pinpoint the region of appearance of gas bubbles within the cavitation plume and to study their spatial distribution, i.e. to determine the structure of the plume. The proposed scheme of the formation of cavitation bubbles allows for two opposed processes in the throttle--the formation of cavitation bubbles in the low pressure region, and their collapse in the region of increasing pressure. It is also shown that the ultrasonic method serves to determine the dependence of the concentration of cavitation bubbles in a fluid on the distance traveled by the flow after its throttling. The method described can also be used to investigate acoustic cavitation. Figures 5; references: 11 Russian.
[81-1386]

USSR UDC 534.222

UNSTEADY QUASI-ONE-DIMENSIONAL ACOUSTIC FLOW IN UNBOUNDED SPACE WITH ALLOWANCE FOR HYDRODYNAMICAL NONLINEARITY

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 25, No 6, 1979 pp 875-881
manuscript received 16 Jan 79

GUSEV, V. E. and RUDENKO, O. V., Physics Department, Moscow State University imeni M. V. Lomonosov

[Abstract] Acoustic flow is described by the equations of motion of an incompressible fluid in an inhomogeneous force field determined by the pattern of the diffraction and attenuation of the sonic beam. In the one-dimensional case, the system of the pertinent equations becomes sufficiently simplified to allow investigating both steady and unsteady flow in a tube. If, however, an unbounded sonic field is considered, with the radius of the tube reaching infinity, the flow rate will unboundedly increase. In this connection, a new simplified system of equations describing unsteady quasi-one-dimensional acoustic flow in an unbounded sonic field is derived. The determining role of hydrodynamical nonlinearity in the process of the onset of the acoustic wind is established, and an exact solution of the nonlinear unsteady problem is derived. The acoustic flow arising with propagation of a diffracting sonic beam in a medium is considered by way of an example. The newly derived system of equations, based on a simplification of the equations of cylindrically symmetric flow, is suitable for the solution of many other problems, such as analysis of the propagation of waves in moving media, or the numerical solution of nonlinear acoustohydrodynamic problems, since the premises on which it is based are sufficiently broad. Figures 2; references: 7 Russian.
[81-1386]

USSR

EFFECT OF SELF-ENHANCEMENT FOR ACOUSTIC WAVES IN A LIQUID WITH GAS BUBBLES

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 7, 5 Oct 79 pp 423-425 manuscript received 6 Aug 79

KOBELEV, YU. A., OSTROVSKIY, L. A. and SUTIN, A. M., Institute of Applied Physics, Academy of Sciences USSR

[Abstract] Acoustic phenomena in a liquid with gas bubbles are compared to electromagnetic effects in a plasma. In particular, resonant absorption of sound in such a two-phase medium is compared to collisionless attenuation. Acoustic solitons have also been observed. The physics of the

acoustic process becomes complicated particularly in cases where the acoustic field changes the state of the gas medium. The authors describe an effect of self-enhancement that is attributable to such action. Experiments were done in a bath measuring 40 x 40 x 80 cm. An acoustic wave was produced by a piezoceramic emitter, and the signal was picked up by a piezoelectric transducer 20 cm away. Bubbles were set up by electrolysis. Weak acoustic waves are strongly attenuated by a bubble layer, but an increase in wave intensity causes an abrupt drop in attenuation. An investigation of the influence of the acoustic field on the size distribution of bubbles showed that there is a sharp drop in the number of bubbles in the measurable size range with an increase in the pressure of the acoustic wave. This self-enhancement effect is attributed to grouping and merging of bubbles under the influence of the Bjorknes force that arises between two oscillating bubbles. The plasma analog is the effect of self-enhancement of Langmuir waves due to their influence on the distribution function. Figures 3, references: 5 Russian.
[59-6610]

USSR

A NEW TYPE OF MAGNETOACOUSTIC OSCILLATIONS IN THIN METAL LAYERS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 9, 5 Nov 79 pp 613-616 manuscript received 17 Sep 79

GOKHFEL'D, V. M. and PESCHANSKIY, V. G., Donetsk Physico-Technical Institute of the UkrSSR Academy of Sciences; Physico-Technical Institute of Low Temperatures, UkrSSR Academy of Sciences

[Abstract] Kinetic effects in conductors that are thin compared with the free path length of charge carriers ($d \ll \ell$) differ qualitatively from the effects in massive conductors, owing to the interaction between the electrons and the metal boundary. This interaction may be of the "mirror reflection" kind. In this connection, collision with the metal boundary may result in electron transfer to, e.g. the other cavity of the Fermi surface intersecting the $p \times n$ = const line at several points. Such "surface transfers" may manifest themselves in the kinetic effects by altering the dependence of the ultrasound absorption factor on the magnetic field applied. This occurs during the propagation of a sound wave along the normal to a thin metal layer with two convex Fermi-surface cavities. Then in the magnetic field parallel to the layer the electrons colliding with one of the layer's boundaries move along open trajectories. It is shown that the attendant processes of energy transfer may result in large-amplitude magnetoacoustic oscillations. Unlike the conventional magnetoacoustic effects, the period of these oscillations contains information

on the mutual alignment of discrete Fermi-surface cavities. Figures 1; references: 5 Russian.
[66-1386]

USSR UDC 533.082.5

INVESTIGATION OF ACOUSTIC WAVES IN A DECAYING ARGON PLASMA FROM A PULSE DISCHARGE

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 4, Jul-Aug 79 pp 711-716 manuscript received 19 Jun 78

SKREBOV, V. N. and EYKHVAL'D, A. I., Leningrad State University

[Abstract] Acoustic waves were studied interferometrically for a decaying pulse discharge plasma in argon (10 mm Hg, 2-3 kV, pulse length 5-20 μsec, tube diameter 20 mm). The cylindrical acoustic wave was repeatedly reflected producing periodic radial compression with large (2-3X) relative increase in density, resulting in modulation of the discharge brightness. An optical interferometer was used to measure the concentrations of electrons and atoms along the axis of the discharge. Two regimes were noted, depending on electron concentration. In the first (electron number 1-5 x 10^{15} cm^{-3}) the increase in brightness was less than the increase in density and was the same for all lines. In the second (electron number 1-3 x 10^{14} cm^{-3}) the high-frequency lines increased in brightness approximately as the cube of N_e and the low-frequency lines approximately as the square of N_e. The intensity increased everywhere when the plasma was compressed on the axis. In regime 1 the primary role was played by electron-atom collisions. Radiative processes became more important as the electron concentration decreased. In regime 2 the main factor was spontaneous radiation after population of upper levels, proportional to the recombination flux, In regime 1 the electron temperature increased with compression; conditions were approximately adiabatic, so that T_e increased by 1.8-2X on first compression. In regime 2, because the recombination is a strong function of temperature, the cubic relationship can be explained by assuming that the acoustic waves were electron-isothermal (T_e = const), which also explains the square relationship for low-level transitions. As regards the mechanism of electron-temperature modulation, in regime 2 the high electron heat conductivity and low heat exchange with heavier particles results in a slow change in T_e on compression. In regime 1, fast equalization of electron and ion temperatures produces a high heat capacity and results in a small role for heat conductivity, producing an adiabatic situation. Figures 3, references 14: 12 Russian, 2 Western.
[87-8480]

USSR

THE SEMICONDUCTOR-SEMIMETAL TRANSITION IN THE ALLOY $Bi_{0.925}Sb_{0.075}$ UNDER TENSION

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 1971-1973 manuscript received 1 Feb 79

BRANDT, N. B., KOLOSOV, V. N., KUL'BACHINSKIY, V. A. and MININA, N. YA., Moscow State University imeni M. V. Lomonosov

[Abstract] General compression produces semiconductor-metal transitions in many substances. Single-axis deformation should produce special effects resulting from symmetry change, but these have not yet been observed because of the small size of achievable deformations. In the present study, a force sufficient to produce a deformation on the order of 0.5% was applied to an elastic ring containing a single crystal disk of the alloy $Bi_{0.925}$-$Sb_{0.075}$ 3 mm in diameter. Current and voltage contacts along the load axis were used for measurement. The effect of tension on the bismuth energy spectrum is to disrupt the equivalence of extrema of L points in the Brillouin band so that one of two extrema drop with respect to the valence band ceiling, increasing the degree of overlap and raising the concentration of current carriers. Transition to the metallic state should result from overlap between L and $T_{\overline{45}}$ terms. Tension on the C_1 and C_2 axes was investigated at 4.2 K with fields ranging up to 45 kOe. Without tension the alloy was a semiconductor with a gap of about 10 meV between the L_a and L_s terms. A sudden drop in resistance was observed at $\sigma_k \sim 10$ kgf. The resulting characteristic degenerate carriers can be used to study isoenergetic surfaces by oscillographic methods. When $\sigma > \sigma_k$, Shubnikov-de Haas oscillations result. The frequency increased with load. The relation of the extremal cross sections of the Fermi surfaces to load was studied over all angles of rotation of H in the binary and bisector planes. The binary-plane Fermi surface included one electron and one hole ellipsoid; the minor axis of the electron ellipsoid coincided with C_2 (parallel to the force) and was inclined at about 6° from the base plane. For the bisector, the Fermi surface was one hole and two electron ellipsoids symmetrical to load axis C_1. There was no change in the angle of inclination of the isoenergetic surface of anisotropy when the load was increased from 18 to 26 kgf. With maximum loads, the oscillation had a frequency of about $1.2 \cdot 10^{-42}$ $(g\text{-}cm/sec)^2$, apparently corresponding with the minimum section of the hole ellipsoid at point T. It is concluded that the semiconductor-metal transition results from overlap between L_a and $T_{\overline{45}}$ terms. Figures 3, references 4: 3 Russian, 1 Western.

[191-8480]

USSR

INFLUENCE THAT RECIPROCAL EXCITATION AND PHONON DRAG HAS ON THERMOELECTRIC AND ACOUSTOELECTRIC EFFECTS IN SUPERCONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 1978-1985 manuscript received 1 Feb 79

GUREVICH, L. E. and KRYLOV, YE. T., Physico-Technical Institute A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] A method of calculating the thermoelectric coefficient with allowance for reciprocal drag of excitations and phonons is presented. The relative contribution of the phonon wind is considerable if the phonons are scattered primarily on excitations rather than defects. In this case the thermoelectric coefficient is practically independent of the electron-phonon interaction constants, in contrast with results obtained by considering only the phonon drag on excitations or neglecting drag altogether. The calculation assumed a single-band super conductor whose electron spectrum is quadratic and isotropic, with only one phonon mode, LA, considered. The method of Landau and Pomeranchuk is used to solve the kinetic equation. For the superconductor, the relative contribution of the phonon wind to the thermoelectric current increases as the temperature falls because the number of excitons drops off exponentially with decreasing temperature and the scattering of phonons decreases. In addition the acoustoelectric effect of ultrasonic vibrations is investigated. These are capable of tearing excitation pairs out of condensates. References 14: 13 Russian, 1 Western. [191-8480]

USSR

SCATTERING OF HOT EXCITATIONS WITH TRANSITIONS TO EXCITED STATES IN POLAR SEMICONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 2028-2035 manuscript received 6 Feb 79

TRALLERO GINER, K., LANG, I. G. and PAVLOV, S. T., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] In calculating the inverse lifetime of a "hot" Wannier-Mott exciton with principle quantum number n = 1, it is necessary to take into account the probabilities of scattering of the excitation with transition to an excited state. The properties of the various transitions are discussed for hot excitations in polar semiconductors with hole and electron interaction with longitudinal optical phonons predominant. The scattering

probability is formulated in terms of Fermi's "golden rule", the ground states and final states are described in terms of wave functions, the conservation laws are applied, and the resulting equations are interpreted. Simplified equations are derived for $n \gg 1$. Graphs of the scattering properties are given as functions of kinetic energy. Figures 4; references 12: 9 Russian, 3 Western.
[191-8480]

USSR

THE OFF-CENTER JAHN-TELLER ION: COUPLED POLAR AND TETRAGONAL DEFORMATION

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 2083-2090
manuscript received 19 Feb 79

VIKHNIN, V. A. and SOCHAVA, N. S., Physico-Technical Institute imeni
A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] An attempt is made to interpret observed properties of the EPR spectra of Ni^+ and Cu^{2+} in SrO. A model of the Ni^+ center which does not assume an additional point defect near the Ni atom is proposed. It is possible for fourth-order anharmonism to be predominant if the polarization energy, Born-Meyer potential and Coulomb energy cancel in the third-order anharmonic equation. The fourth-order anharmonic potential equation is set up and an approximation of the adiabatic potential derived. The potential has 4 minima, each with two tetragonal deformations of different magnitude. Accordingly the symmetry of the Jahn-Teller ion is C_1, which agrees with experiment. It is shown that the tunneling probability is highest between two wells in the direction of the maximum Jahn-Teller effect deformation; maximum anisotropy of the g-factor is expected in this direction. Rising temperature results in faster transitions and accordingly broadening of lines and leveling of the spectrum, as observed experimentally. A similar analysis explains higher-temperature leveling. The approach to Cu^{2+} in SrO uses an 8-hole potential and third-order anharmonism. Thanks are expressed to Yu. N. Toplarov for discussion. References 16: 11 Russian, 5 Western.
[191-8480]

USSR

METAL-DIELECTRIC TRANSITION IN MANY-VALLEY SEMICONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 2171-2173 manuscript received 6 Feb 79

ANDRYUSHIN, YE. A., GEL'FOND, O. A. and SILIN, A. P., Physical Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] The metal-dielectric transition is considered in a system of impurities in many-valley semiconductors. The critical density of the transition is defined in terms of zero binding energy of the donor, which is in turn determined by solving the Schrodinger equation for an electron in a screened Coulomb potential (static plasma screening of Coulomb interaction). The Thomas-Fermi approximation is used. For the degenerate case, numerical integration of the Schrodinger equation with screened Coulomb potential is carried out using Hubbard's approximation. A graph of calculated results for the following numbers of electron valleys is given: 1, 4 (Ge), 6 (Si), and 10 ($Ge_{0.85}Si_{0.15}$). The results agree with figures previously derived when T = 0. The temperature dependence of the critical density is increasing for 1 and 4 valleys and decreasing for 6 and 10 valleys (because in this model the temperature correction to the screening has changing sign). Similar effects are observed in P-doped silicon. Thanks are expressed to L. V. Keldysh for interest and discussion. Figures 1, references 7: 1 Russian, 6 Western.
[131-8480]

USSR

ON THE QUESTION OF EXACT SOLUTIONS IN THE THEORY OF SEMICONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 2175-2177 manuscript received 7 Feb 79

ROGOZHKIN, V. V. and VASIL'YEV, L. I., Leningrad Institute of Precision Mechanics and Optics

[Abstract] In dealing with the problem of using pure metals as semiconductors, the nonlinear Ginzburg-Landau equations are solved for a wide range of magnetic field values. It is necessary to use approximate calculation methods. But some physically nontrivial problems with exact solutions exist. The exact solution of the system of equations for the plane problem with axial symmetry when $\kappa = 1/\sqrt{2}$ is presented. This applies, for example, to pure niobium near the critical temperature. The solution is in the

form of a recursive equation. When the solution is known it is possible to calculate the deformation field created by a loop in an elastic continuum semiconductor, and the distribution of the magnetic field in the vicinity of the loop. References 4: 2 Russian, 2 Western.
[191-8480]

USSR

THE EFFECT OF SPECULAR REFLECTION ON THE POLARIZATION OF SCATTERED LIGHT IN RESONANCE EXCITATION OF EXCITONS IN CRYSTALS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 7, Jul 79 pp 2182-2184 manuscript received 8 Feb 79

IVCHENKO, YE. L. and YULDASHEV, N. KH., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] A theoretical study is made of the polarization of radiation multiply scattered in a semibounded crystal with excitation by polarized light. Specular reflection of light exiting from the crystal is assumed, which affects its polarization. Isotropic crystals only are considered. The radiation transmission equations are formulated in terms of the Stokes parameters, which are related to the initial four-component flux and a scattering matrix. The latter adds a term for specular reflection. The Stokes parameters are calculated for normally incident exciting light, producing two independent linear integral equations and a system of three linear integral equations, which are solved by computer. A graph of the degree of linear and nonlinear polarization of light emitted "back" as a function of the albedo in stimulation by linearly and circularly polarized light is given. When there is multiple scattering the two polarizations are less than 100%. For conservative medium the linear polarization is about 32% and the circular polarization about 24% without reflection. With reflection the values are below 4% because of the limited angle at which exit is possible in semiconductors. A graph of polarizations with single and double scattering is presented. Thanks are expressed to G. Ye. Pikus and N. A. Silant'yev for discussions. Figures 1, references 5: 3 Russian, 2 Western.
[191-8480]

USSR

CONTROLLING THE TRAJECTORIES OF CHARGED PARTICLES BY USING A BENT SINGLE CRYSTAL

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 7, 5 Oct 79 pp 474-478 manuscript received 11 Aug 79

VODOP'YANOV, A. S., GOLOVATYUK, V. M., YELISHEV, A. F., IVANCHENKO, I. M., KADYROV, R. B., KARPENKO, N. N., KOREN'KOV, V. V., NIGMANOV, T. S., RYABTSOV, V. D., SENNER, A. YE., SITAR, B., STARCHENKO, B. M., SUTULIN, V. A., TYAPKIN, I. A., URAL'SKIY, E. V., FILATOVA, N. A., TSYGANOV, N. N., SHAFRANOV, M. D., Dubna, WOJTKOWSKA, I., GUZIK, Z., ZELAZNY, R., FORYCHI, A., Swierk, GRISHAYEV, I. A., KOVALENKO, G. D., SHRAMENKO, B. I., Khar'kov, BAVIZHEV, M. D., BULGAKOV, N. K., Tomsk, KARRIGAN, R., TUIG, T., Batavia, GIBSON, V. M., SAN, CH. R., IK-DZHO KIM, FELPS, DZH., New York, and AVDEYCHIKOV, V. V., Leningrad

[Abstract] It has been experimentally predicted that deformed single crystals can be used to control the trajectories of charged particles captured in channeling. This paper is a report of an experiment done to check this hypothesis on the electron linac at the Joint Institute of Nuclear Research in Dubna. It is shown that 8.4 GeV protons captured in planar channeling by a bent silicon single crystal are deflected through an angle of up to 26 mrad. The radius of curvature of the particle trajectory was about 38 cm, which corresponds to an average transverse electric field of about 240 MV/cm acting on the particle. This is the equivalent of a magnetic field with induction of about 0.82 MGs. Figures 4; reference: 1 Russian.

[59-6610]

USSR UDC 532.593+539.129

SHOCK WAVE FRONT STRUCTURE IN A LIQUID

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 249, No 24, 1979 pp 840-843
manuscript received 30 Jul 79

KLIMENKO, V. YU. and DREMIN, A. N., Chernogolovka, Moscow Oblast, Institute of Chemical Physics Affiliate of the USSR Academy of Sciences

[Abstract] The shock wave front structure in a liquid was investigated by the method of molecular dynamics of equilibrium systems. In this method, a real substance is simulated by a limited number of particles (of the order of 100-1000) whose equations of motion are numerically integrated so that the coordinates and velocities of all the particles are known at any time instant, thus making it possible to compute from corresponding formulas the required macroscopic properties of the system, on using periodic boundary conditions to eliminate the effect of the walls. A cell containing 2,592 atoms of argon, simulating liquid argon, was used in the calculations. The differential equations of motion of the particles were numerically solved on a BESM-6 computer. Liquid argon with all the structural and kinetic features characteristic of its liquid form was simulated by specifying corresponding densities and temperatures of the system. The shock wave was generated by inducing a particle layer to move at mass velocity u in the x-direction so as to compress the substance so that a shock wave would propagate throughout the cell. It was found that in the shock wave the transition of matter to the compressed and heated state occurs extremely rapidly, within $\sim 10^{-12}$-10^{-13} s, which is a time period equal to that of translational relaxation. Hence equilibrium with respect to translational degrees of freedom is absent in the shock wave front. Analysis of the evolution of the molecular velocity distribution function on transition across the shock wave showed that the function is an equilibrium function, i.e. a Maxwellian function, only in front of and behind the shock wave front, whereas within the front it is markedly distorted. Hence the concept of thermodynamic temperature is not applicable to the shock wave front, and in this case only the mean kinetic energy of particles (kinetic temperature) can be considered. The width and structure of the front are similar for both strong and weak waves. Figures 3; references 9: 3 Russian, 6 Western
[67-1386]

USSR UDC 532.517.4

CALCULATION OF A TURBULENT BOUNDARY LAYER ON A PLATE WITH INTENSE BLOW-IN

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 37, No 4, Oct 79
pp 589-593 manuscript received 25 Apr 78

DYMANT, L. N. and SPANOVSKIY, V. M., Sevastopol' Instrument Making Institute

[Abstract] A theoretical analysis is made of turbulent boundary layers on a permeable plate with intense blow-in where there is no friction on the wall. The technique is based on a two-zone boundary layer model that assumes an external jet zone with a universal velocity profile, and an internal zone near the wall. By using a universal velocity profile in the external zone the authors are able to reduce the problem of boundary layer analysis to determination of the velocity profile in the inner zone and determination of the parameters of the interface between zones. The calculation utilizes integral equations of momenta for the layer as a whole, and for its internal zone. The results of the calculation are compared with experimental data and found to agree satisfactorily. Figures 3, references 19: 15 Russian, 4 Western.
[58-6610]

USSR UDC 517.9:533.7

FLOW AROUND BLUNT BODIES WITH POINTS AND DEPRESSIONS

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 37, No 4, Oct 79
pp 712-716 manuscript received 29 Nov 78

DAVYDOV, YU. M., DOROBITSYN, G. P. and POSTNIKOV, V. G.

[Abstract] Even slight changes in the shape of the generatrix of solids of revolution can have a strong effect on aerodynamic drag. Singularities like points and depressions in the region of the nose section are particularly significant in this regard. The authors analyze the flow of an ideal gas around such bodies in the two-dimensional formulation. The numerical study covers velocities of the oncoming flow in a range of $0.9 \leq M_\infty \leq 7.0$. The analysis is based on the "coarse particle" technique. It is shown that the use of sharp points can reduce head drag by 30-50%, while depressions increase drag by 6-8% depending on size. Figures 2, references: 11 Russian.
[58-6610]

USSR UDC 534.23:532.528

CLOSURE OF A SPHERICAL CAVITATION BUBBLE BETWEEN TWO RIGID WALLS

Minsk IZVESTIYA AKADEMII NAUK BSSR. SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 5, 1979 pp 107-113 manuscript received 21 Dec 78

DEZHKUNOV, N. V., KUVSHINOV, G. I. and PROKHORENKO, P. P., Physico-Technical Institute, Belorussian SSR Academy of Sciences

[Abstract] Situations in which a bubble forms in between two rigid walls are fairly frequent in, e.g. ultrasonic cleaning of flat surfaces, deposition of metal coatings, impregnation, etc. In this connection, the conditions of closure of the bubble were investigated. It is shown that the presence of the second wall results in a decrease in the rate of closure of the bubble compared with bubbles forming in the neighborhood of a single wall, because the second wall impedes the influx of liquid to the bubble enclosed in between two walls. This appears to be a major reason for the decrease in the erosive effect of acoustic cavitation arising in the gap between the emitter and the surface being treated. The investigation was carried out with respect to spherical bubbles; it will be continued with respect to cavitation bubbles of other shapes. Figures 2; references 10: 9 Russian, 1 Western.
[54-1386]

USSR UDC 537.226:536.24:532.551

THE EFFECT OF AN ELECTRIC FIELD ON FLOW AND HEAT EXCHANGE OF A DIELECTRIC FLUID IN AN ANNULAR CHANNEL

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 4, Jul-Aug 79 pp 777-782 manuscript received 9 Oct 78

MAL'KOVSKIY, V. I. and MURATOVA, T. N., Power Institute imeni G. M. Krzhizhanskiy

[Abstract] The effect of an electric field on flow and heat exchange of a dielectric fluid in an annular channel is of importance to the development of cryogenic high-voltage engineering. A theoretical study is made of stationary flow of a dielectric fluid in a channel formed by two coaxial cylinders, with a constant potential difference between the walls, a heat flow through the outer wall and an adiabatic inner wall. On the basis of certain simplifying assumptions it is demonstrated that the equations of motion and energy can be solved separately for the small heat fluxes characteristic of stationary operation of a coaxial cryocable containing helium. The rate field is determined for an infinite channel. There is

a dual effect: on one hand the rate of Poiseuille flow is increased, while on the other hand the flow is slowed at the outer wall and accelerated near the inner wall. A graph of the temperature field is presented. It is found that heat transfer worsens when an electric field is applied because of slowing of the flow at the heated wall. When the wall is cooled, the flow rate along it increases and heat exchange is improved. Figures 3, references 9: 7 Russian, 2 Western.
[187-8480]

USSR UDC 621.375.826

EXPERIMENTAL STUDY OF A GASDYNAMIC CO_2 MIXER LASER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248, No 1, 1979
pp 81-83 manuscript received 10 Jun 79

VYSKUBENKO, B. A., DEMENYUK, YE. T., KIRILLOV, G. A., KOLOBYANIN, YU. V.,
KORMER, S. B. and NITOCHKIN, N. A.

[Abstract] An experimental investigation is made of the energy characteristics of a gasdynamic mixer laser with flat nozzle at a pressure of up to 50 atmospheres and a temperature of up to 3000 K. Nitrogen is heated by an electric explosion, the expanded nitrogen bursts a diaphragm and flows through a flat supersonic nozzle into the optical cavity of the laser. The nozzle is 17 cm wide and has a critical height of 0.16 cm. The nozzle has a geometric degree of expansion of 15.5. Premixed CO_2 and He are injected into the region of the critical section of the nozzle. Lasing is achieved by means of two single-pass resonator cavities in series one after the other. Maximum specific energy output was 54 J/g. Comparison with the best homogeneous gasdynamic lasers shows that the mixer laser is superior in energy characteristics. Figures 2; references 7: 5 Russian, 2 Western.
[45-6610]

USSR

OBSERVATION OF COHERENT INTERACTION BETWEEN A NANOSECOND PULSE OF A CO_2 LASER AND THE AMPLIFYING MEDIUM

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in
Russian Vol 30, No 9, 5 Nov 79 pp 593-595 manuscript received 23 Aug 79

BARANOV, V.YU., BORZENKO, V. L., MALYUTA, D. L., PETRUSHEVICH, YU. V.,
SAMOV, YU. A., SEBRANT, A. YU., SMAKOVSKIY, YU. B., STAROSTIN, A. N. and
STREL'TSOV, A. P.

[Abstract] Coherent effects may be of major importance to the formation of ultrashort pulses in the amplifying medium so as to obtain short tailored CO_2 laser pulses for utilization in thermonuclear research. In this connection, the first ever observation of the breakdown of a nanosecond pulse during its amplification in a CO_2 laser is now reported on. The original pulse was produced with the aid of a CO_2 atmospheric-pressure laser system, an electrooptical shutter, and an atmospheric-pressure preamplifier. A mirror system was then used to accomplish several passages of the original pulse in the CO_2 amplifier. The pulse shape was recorded with the aid of

a pyroelectric sensor. The time resolution of the oscillograph used was 0.7 ns. The oscillograms revealed a marked sharpening of the leading edge of the pulse and its separation into two "2π" pulses. These experimental findings were qualitatively-corroborated by numerical calculations based on a system of equations allowing for coherent interaction as well as for rotational and vibrational intra- and intermodal relaxation. Figures 2; references 10: 3 Russian, 7 Western.
[66-1386]

USSR

GIANT OSCILLATIONS OF THE PASSAGE OF A QUASI-SURFACE SPIN WAVE ACROSS AN YTTRIUM-IRON GARNET (YIG) THIN FILM

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 9, 5 Nov 79 pp 600-603 manuscript received 25 Aug 79

GLUYAYEV, YU. V., BUGAYEV, A. S., ZIL'BERMAN, P. YE., IGNAT'YEV, I. A., KONOVALOV, A. G., LUGOVSKOY, A. V., MEDNIKOV, A. M., NAM, B. P. and NIKOLAYEV, YE. I., Institute of Radio Engineering and Electronics, USSR Academy of Sciences

[Abstract] Previously predicted giant oscillations of the Daman-Eshbach coefficient of wave passage across a thin epitaxial YIG film were for the first time experimentally observed and interpreted. To this end the excitation and propagation of a quasi-surface spin wave in single-crystal YIG films were investigated. Measurements of the delay time of the microwave pulse showed that the antennas excited a Daman-Eshbach wave. The attendant giant oscillations are linked to the decay of the Daman-Eshbach wave rather than to its spectrum. This newly discovered effect is of interest since it reveals a nontrivial structure of the Daman-Eshbach wave in thin ferromagnetic films with a narrow FMR line. The existence of passage maxima should be taken into account in the ongoing attempts to observe the amplification of the Daman-Eshbach wave by the electron current in structures with an adjoining semiconductor. Figures 3; references 7: 3 Russian, 4 Western.
[66-1386]

USSR UDC 621.375

THE EFFECT OF PRESSURE ON THE FORMATION OF A POPULATION INVERSION IN A CO_2 GASDYNAMIC LASER WITH A MIXTURE OF $CO + N_2O + (N_2 + He)$

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 4, Jul-Aug 79 pp 717-721 manuscript received 19 Jul 78

KUDRYAVTSEV, N. N., NOVIKOV, S. S. and SVETLICHNYY, I. B., Institute of Chemical Physics, USSR Academy of Sciences, Moscow Physico-Technical Institute

[Abstract] The effect of pressure (5, 10 and 20 atmospheres) on the population inversion in a CO_2 gasdynamic laser with CO and N_2 using a shock tube and nozzle was studied. The vibration temperatures of asymmetric and symmetric vibration modes of CO_2 were measured; this gave the population of the N_{001} and N_{100} (upper and lower) laser levels and provided a measure of stimulated and spontaneous radiation. Initial proportions were 0.05 N_2O, 0.25 CO, 0.4 N_2, 0.3 He and the temperature range before the nozzle was 1,600-3,000 K. A continuous increase in the gain coefficient was observed as the pressure was increased from 5 to 20 atm, while the optimal conditions shifted toward higher temperatures. This is explained by a decreasing population in the lower laser levels. Graphs of the gain coefficient, relative population inversion, vibrational temperature of the asymmetric mode for CO_2 and vibrational temperature of the joint mode for CO_2 as functions of temperature are presented for the three pressures used. Figures 4; references 13: 8 Russian, 5 Western.
[187-8480]

USSR UDC 533.932

OPTICAL PROPERTIES OF HYDROGEN PLASMA WITH ADDITION OF POTASSIUM

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 27, No 4, Jul-Aug 79 pp 673-677 manuscript received 22 Jul 78

KUZNETSOVA, N. I. and LAPPO, G.B., Moscow

[Abstract] The addition of an alkali metal with a low ionization potential to hydrogen results in a strongly ionized plasma at 3000-5000 K. In addition to the usual potassium absorption lines, the following elementary absorption processes must be taken into account: absorption by the KH molecule (low temperature), hydrogen lines (about 10,000 K), photostripping of electron from H^-, and H_2 bands (UV). The calculation for KH is based on the Franck-Condon factors and solution of the Schrodinger equation by the Numerov numerical method. Also taken into account are IR absorption in V-R transitions of KH, and high-pressure V-R transitions in the $(H_2)_2$ quasimolecule. The spectral coefficient for quasimolecules is calculated for $\Delta j = 0 \pm 2$ in the range 2,000-10,000 cm^{-1}, and k_{abs} is calculated for various parameters (mixtures with 3, 10 and 50 mole percent of K, pressures of 1, 10, 100 and 500 x 10^5 Pa, T = 3,000-4,000 K). Correction is made for stimulated emission. A table of radiant heat conductivity coefficients is included. Figures 1; references 16: 3 Russian, 13 Western.
[187-8480]

USSR UDC 621.313.522.21

SIMULATION OF NONEQUILIBRIUM PHYSICAL AND CHEMICAL PROCESSES IN SUPERSONIC FLOW OF COMBUSTION PRODUCTS IN AN OPEN-CYCLE MDH GENERATOR

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 4, Jul-Aug 79 pp 849-837 manuscript received 9 Jul 78

PRUSOVA, N. M., Siberian Power Institute, Siberian Department, USSR Academy of Sciences

[Abstract] At high flow velocities, regions of flow with nonequilibrium processes may occur in MHD generators, producing changes in composition and thermodynamic and transport properties. A model is presented of the effect of chemical and ionization nonequilibrium and nonequilibrium electron capture on the thermodynamic properties of the working medium. Simplifying assumptions are: equilibrium composition and thermodynamic properties in the critical section of the nozzle; consideration only of changes in the concentration of K^+, OH^- and e^-; no effect on temperature and pressure from

neutral components from recombination of ions. A system of kinetic equations using reaction constants for the various reactions taken into account is set up, and a procedure for numerical solution by computer outlined. Graphs of the following factors are presented: effect of the energy of affinity of OH for the electron on variation of electron density; change of mole percentages of NO and O as a function of the parameter $\overline{F}$ in the nozzle and channel; and change of electron density as a function of temperature; all for both equilibrium and nonequilibrium conditions. In addition a table of the mole percentage of CO_2 as a function of $\overline{F}$ is presented. It is found that variations in the concentrations of H_2O, CO_2 and e^- occur at speeds V greater than 1500 m/sec and for small pressures (below 1 MPa) in the combustion chamber. Thanks are expressed to Yu. G. Pirumov for help in calculations and to N. M. Pshenichnov for assistance in the work. Figures 4; references 20: 14 Russian, 6 Western.
[187-8480]

USSR

ATOMS AND MOLECULES IN THERMAL INEQUILIBRIUM AS FACTORS IN THE BRANCHED CHAIN REACTION BETWEEN HYDROGEN AND FLUORINE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248, No 3, 1979 pp 610-613 manuscript received 14 May 79

NIKEROV, V. A., RUSANOV, V. D. and SHOLIN, G. V., Moscow, Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The effect of the translational inequilibrium of atoms and molecules on the hydrogen-fluorine chain reaction rate and chain interaction is investigated. Examination of the [H]/[H] + [F] ratio as a function of the partial concentration of F_2 in the mixture shows that in the presence of low partial concentrations of molecular fluorine the rupture of the chain occurs on hydrogen atoms, whereas at high concentrations of that element chain rupture on fluorine atoms begins to become significant. Another important manifestation of the thermal inequilibrium of the chain-reaction products is the possibility of branching of the chain owing to the translational energy of these products. The translational inequilibrium of the products of chemical reactions apparently is a major factor in the interaction of hydrogen, deuterium, and tritium with mixtures of halogens and interhalide compounds. These findings are of interest to research into chemical lasers. Figures 3; references 14: 4 Russian, 10 Western.
[48-1386]

USSR UDC 621.311.25:621.039:697.34

MATHEMATICAL MODEL OF OPTIMIZATION OF THE STRUCTURE OF ATOMIC SOURCES OF HEAT

Moscow ATOMNAYA ENERGIYA in Russian Vol 47, No 4, Oct 79 pp 241-244
manuscript received 9 Oct 78, after revision 18 Jan 79

BRAILOV, V. P., VORONKOV, M. YE. and CHAKHOVSKIY, V. M.

[Abstract] The authors discuss methods of comprehensive optimization of the structure of nuclear heat sources with consideration of systems factors (primarily indices of the external fuel cycle). One effective way to settle the problem is by using computers in the method of mathematical economic modeling. To work out forecasts in nuclear engineering, mathematical models have been developed for optimizing the structure of this branch of industry, and for determining the role of different types of reactors in power systems, the cost of plutonium and so on. Such a model is proposed for optimizing the structure of nuclear sources of heat supply with consideration of development of the nuclear industry. The optimization is based on selecting one of the possible versions of the heat supply system for each city in accordance with the global optimum in development of nuclear power engineering. The resultant model enables optimization by types of power plants and installed equipment in a systems approach with regard to the dynamics of development and interaction among different kinds of nuclear power sources. An estimate can be made of the relative effectiveness of different types of nuclear heat sources and organization of chemical processing of spent fuel. The model also provides a basis for optimizing the conversion of stations from one kind of fuel to another. Calculations based on the proposed model using preliminary initial data show that the structure of nuclear heat sources is strongly affected by the cost and available resources of natural uranium and the organization of chemical processing of spent fuel in addition to the specific capital investments in power plants of various types and local conditions. References: 4 Russian.
[49-6610]

USSR UDC 621.039.5:539.12.03

FISSION PRODUCTS AS GAMMA SOURCES

Moscow ATOMNAYA ENERGIYA in Russian Vol 47, No 4, Oct 79 pp 247-253
manuscript received 25 Sep 78, after revision 29 Mar 79

STARIZNYY, YE. S., MARKINA, M. A. and CHERKASHIN, V. A.

[Abstract] A brief survey of the literature on the principal characteristics of gamma radiation of ^{235}U fission products. An analysis is made of

the capabilities of radiation facilities in which the gamma sources are completely depleted fuel elements, elements that are repeatedly transferred back and forth between the reactor core and the irradiator, and a uranium radiation loop. The authors discuss the parameters of facilities with depleted fuel elements, and with transfer of fuel elements back and forth between the reactor core and the irradiator. It is shown that a uranium radiation loop can be effectively used in industrial facilities. Figures 6, references 51: 37 Russian, 14 Western.
[49-6610]

USSR UDC 621.384.64.01

LOSSES OF PARTICLES IN A PROTON LINAC DUE TO RANDOM ERRORS OF THE PARAMETERS OF THE FOCUSING CHANNEL

Moscow ATOMNAYA ENERGIYA in Russian Vol 47, No 4, Oct 79 pp 254-258
manuscript received 2 Dec 77

OSTROUMOV, P. N. and FATEYEV, A. P.

[Abstract] In ring accelerators, particle losses due to random perturbations of motion can be found analytically by the Einstein-Fokker equation. It is shown in this paper that an analogous method can be used in linear proton accelerators as well for calculating the losses of particles due to random errors in the alignment and the parameters of the focusing elements. The solution of the problem is based on the assumption that the density of the propagated charge in the beam can be disregarded. The proposed method can be used to find the distribution of losses of particles along the accelerator, and to calculate the losses in real focusing channels. This is particularly important in the case of "meson factories" where relative losses must not exceed 10%. The results of loss calculation are given for some working linacs, and are compared with experimental data. It is concluded that manifestation of a beam "halo" may be due to random errors in the focusing channel of the accelerator. Figures 3; references 7: 6 Russian, 1 Western.
[49-6610]

USSR UDC 538.121.8

INTERACTION OF HEAVY-CURRENT RELATIVISTIC ELECTRON BEAM WITH MATTER

Moscow ATOMNAYA ENERGIYA in Russian Vol 47, No 5, 1979 pp 328-332
manuscript received 20 Nov 78

DIDENKO, A. N., CHISTYAKOV, S. A. and YALOVETS, A. P.

[Abstract] The behavior of matter interacting with heavy-current electron beams (HCEB) is known to differ from its behavior when interacting with conventional (non-intense) electron beams. While complete solution of this complex question is as yet not feasible, the problem of finding the fast electron flux in matter under HCEB is simpler, and the solution of this problem would serve to clarify the basic patterns of behavior of HCEB in matter. Accordingly this approach was adopted in conducting a numerical investigation of such interactions. It is shown that the transfer of energy to the substance of the target by the electron beam occurs not only through inelastic collisions but also through the conversion of the Coulomb energy of interaction (of fast neutrons with the field) to thermal energy upon dissipation of the space charge generating that field. It is further shown that the increase in the density of the incident current in the presence of a fixed conductivity of the medium results in a redistribution of the energy spent on the matter. In this connection, the anomalous energy absorption in thin foils upon passage of HCEB through them is tentatively attributed to the effect of the Coulomb field on the transport of fast electrons. Figures 3; references 8: 6 Russian, 2 Western.
[79-1386]

USSR UDC 539.17

CROSS SECTIONS FOR FISSION OF ^{235}U AND ^{238}U BY 14.7 MeV NEUTRONS

Moscow ATOMNAYA ENERGIYA in Russian Vol 47, No 6, Dec 79 pp 416-418
manuscript received 24 Jan 79

ALKHAZOV, I. D., DUSHIN, V. N., KOVALENKO, S. S., KOSOCHKIN, O. I., PETRZHAK, K. A., SHPAKOV, V. I.: Soviet Union, ARL'T, R., VAGNER, V., VAYDKHAZE, F., GRIMM, V., KRAUZE, R., MUZIOL', G., ORTLEPP, KH. and TAYKHNER, R., East Germany

[Abstract] Absolute measurements were done on the fission cross sections for ^{235}U and ^{238}U with fission by neutrons with energy of 14.7 MeV. The research was done jointly by Dresden Technical University and the V. G. Khlopin Radium Institute in Leningrad on the facilities and accelerator of

Dresden Technical University. The measurements were made by the technique of coincidence of fission fragments. The neutron generator used the reaction $T(d,n)^4He$ with deuteron energy of 130 keV. The fissile target was exposed to neutrons at an angle of 13° to the deuteron beam. The particle detector was a thin scintillation counter. The results of the measurements give a fission cross section of 2.073±0.023 barns for ^{235}U, 1.194±0.022 barns for ^{238}U and a resultant ratio of 0.576±0.012 for the two isotopes. The authors thank P. Raics of Debrecen, Hungary for calculating the neutron energy under the conditions of the experiment. References 15: 2 Russian, 13 Western.
[78-6610]

USSR UDC 523.11

EXPERIMENTAL DETERMINATION OF ACCELERATION OF FREE FALL OF A RELATIVISTIC CHARGED PARTICLE. II. A CYLINDRICAL SOLENOID IN A STATIONARY FIELD OF FORCES OF INERTIA

Tomsk IZVESTIYA VUZov: FIZIKA in Russian No 8(207), 1979 pp 28-32
manuscript received 12 May 78

GONYAYEV, V.V., All-Union Scientific Research Institute of Physicotechnical and Radiotechnical Measurements

[Abstract] In the first part of this research [Izv. vuzov: fizika, No 4, 1977, p 7] the author formulated the problem of motion of a relativistic charged particle in a constant homogeneous magnetic field under the action of stationary forces of inertia defined by the vectors $\vec{W}$, $\vec{a}$ = const. It is pointed out that the electromagnetic field is influenced by inertial forces, which must be taken into consideration in calculating the electric and magnetic fields that arise in a long cylindrical solenoid. Taking the radius-vector of the particle as very small compared with the radius of the earth, $\vec{W}$ and $\vec{a}$ can be considered small parameters and applied in the linear approximation to the problem of finding the general-relativity correction to the electromagnetic field. The method is used to determine the acceleration of free fall of a relativistic charged particle in an arbitrarily oriented infinite cylindrical solenoid at rest in a steady-state field of intertial forces. It is shown that an electric field associated with the angular rate of rotation of the local coordinate system arises inside and outside of the solenoid. References 7: 5 Russian, 2 Western.
[60-6610]

USSR UDC 530.12:531.51

A NEW SOLUTION OF THE EINSTEIN-DIRAC EQUATIONS

Tomsk IZVESTIYA VUZov: FIZIKA in Russian No 8(207), 1979 pp 91-95
manuscript received, 20 Jun 78, after revision 29 Jan 79

GUTS, A. K., Omsk State University

[Abstract] The author considers the dynamics of self-gravitating spinor matter within the framework of general relativity theory as described by the Einstein-Dirac equations. A study of the solution of these equations will in time answer the questions of whether a broader notion of the structure of matter with consideration of internal degrees of freedom (spin) of a medium will alter the problem of singularities, and whether it is possible to geometrize neutrino fields in the Wheeler-Raynich sense. In connection with these questions the derivation of special solutions of these equations is examined, in particular the problem of gravitational radiation of neutrino flux. It is assumed that the neutrino field is planar and propagates in the positive direction of the x-axis, and that the gravity field it produces is a wave field. References 8: 6 Russian, 2 Western.
[60-6610]

USSR

GENERATION OF HEAVY IONS WITH Z > 20

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 8, 20 Oct 79 pp 489-491

BYKOVSKIY, YU. A., LAGODA, V. B. and SHEROZIYA, G. A., Moscow Institute of Engineering Physics

[Abstract] An experimental study was made to analyze the fission products in hot plasma spots of a plasma diode. For this purpose, a low-inductance capacitor across a pair of pure-metal electrodes was placed in a vacuum chamber. Discharge was initiated with a laser pulse focusing on one of the electrodes and the discharge current was allowed to reach 100 kA after 1.5 μs. An analysis of the ion signal spectrum and energy distribution has revealed an emission of heavy particles with $M > 100$ and $Z > 20$ (Sn^{+21}, Ta^{+22}, W^{+23}, Pb^{+25}, Bi^{+25}), their ionicity increasing with their mass, which explains the more efficient ionization during slowdown of plasma dissipation and indicates a "quenching" of ions during fission of hot plasma spots in a noninductive discharge without recombination during dissipation of a plasma cluster in vacuum. The authors thank V. L. KANTSYREV for helping with the experiments. Figures 3; references 3: 1 Russian, 2 Western.
[64-2415]

USSR

INDUCED CAPTURE OF A NEUTRON BY NUCLEI IN A LASER RADIATION FIELD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 8, 20 Oct 79 pp 541-545 manuscript received 2 Jun 79

ZARETSKIY, D. F. and LOMONOSOV, V. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] Negative p-levels below but close to the neutron bond energy in compound nuclei can be examined by a method involving the use of an external laser field. With the aid of the wave function of atoms in the saturation state, and with retardation disregarded, an expression for the intensity of the high-frequency electric field at the nucleus is derived from an expression describing the charge density and the transition current in the atom due to that field. Considering the entrapment of thermal neutrons at a negative p-level, in this case induced by the high-frequency internal field of the atom, the cross section for resulting nuclear reactions is then calculated on the basis of the interaction Hamiltonian pertaining to a neutron in the laser-induced high-frequency field and with the Fourier transform of a nuclear reaction. This cross section is subsequently averaged over the initial neutron energy distribution, with the integral easily evaluated in the cases of resonance or far from resonance. References: 3 Russian.
[64-2415]

USSR

DIFFERENTIAL SPECTRUM OF CONVERSION ELECTRONS AND EXCITATION ENERGY OF THE (1/2$^+$) ISOMER OF URANIUM-235

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 8, 20 Oct 79 pp 549-553 manuscript received 21 Aug 79

ZHUDOV, V. I., ZELENKOV, A. G., KULAKOV, V. M., MOSTOVOY, V. I. and ODINOV, B. V.

[Abstract] The differential spectrum of U^{235m} conversion electrons was measured for the first time, with a Hewlett-Packard HP5950A ESCA spectrometer, in a study of the nuclear conversion of an E3-transition at the outer electron shells of a uranium atom generally and the decay of the ($\frac{1}{2}^+$) U^{235m} isomer to ($7/2^-$) U^{235}. Alpha decay of a plutonium-239 specimen served as the source of uranium isomer atoms, the latter was collected electrostatically in a pure helium atmosphere, and a layer of polycrystalline UF_4 on gold foil served as the matrix whose photoelectron spectrum

under exposure to x-radiation was also measured concurrently for identification of peaks. The difference between kinetic energies of conversion electrons and photoelectrons respectively was found to be 1409.8±0.5 eV, making the energy of isomeric $(1/2^+) \rightarrow (7/2^-)$ transition of uranium-235 equal to 76.8±0.5 eV. The authors thank A. I. LEONOV, and V. M. SHATINSKIY for helping with the work, also D. P. GRECHUKHIN, A. A. SOLDATOV and YU. A. TETERIN for the useful comments made during the discussion of the results. Figures 2; references: 10 Western.
[64-2415]

USSR

USE OF A HEAVY-CURRENT RELATIVISTIC ELECTRON BEAM TO ACHIEVE STRUCTURAL AND CHEMICAL TRANSFORMATIONS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 9, 5 Nov 79 pp 611-613 manuscript received 10 Sep 79

BATSANOV, S., DEMIDOV, B. A. and RUDAKOV, D. I.

[Abstract] Self-focusing of the relativistic electron beam (REB) in the diode in modern pulsed heavy-current accelerators results in a power density of $> 10^{12}$ watt/cm^2 at the focal spot at the anode. The energy release accompanying such a high current density results in the thermal explosion of the anode surface. The vapors of the investigated substance, propagating at high velocities, carry a considerable momentum which causes the appearance of powerful shock waves in the investigated substance. Considering that the attendant pressure P of the plasmoid forming at the focal spot may reach high values such as 2.5 millibar, as corroborated by metallographic analysis of copper targets exposed to the REB, boron nitride and graphite were experimentally placed at the focal spot of the accelerator, and it was found that then hexagonal BN and graphite undergo partial ($\lesssim$ 10%) transformation into fine-disperse diamond phase. In addition, the combined effect of high pressures and temperatures may be extremely promising to chemical synthesis. The REB-induced reaction $CuBr_2 + Cu \rightarrow CuBr$ was 100% successful. REB can be used to readily obtain carbides of copper and iron without the usual prolonged heating. But it appears that the most promising use of this method will be in achieving chemical interactions whose initiation requires overcoming high potential barriers (activation energies). Figures 2; references 7: 6 Russian, 1 Western.
[66-1386]

USSR

PRELIMINARY FINDINGS ON DEEP INELASTIC ANTINEUTRINO-NUCLEON INTERACTIONS WITH 2-25 GeV ENERGIES IN THE SKAT BUBBLE CHAMBER

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 9, 5 Nov 79 pp 627-630 manuscript received 24 Sep 79

KORABLEV, V. M., KOROTKOV, V. A., KUZNETSOV, YE. P., MAKEYEV, V. V., NIKITIN, YU. P., POLYARUSH, A. YU., SOKOLOV, A. A., SMINROV, YU. I., BARANOV, D. S., IVANILOV, A. A. and KONYUSHKO, V. I.

[Abstract] The experiment was carried out in the CF_3Br-filled SKAT bubble chamber exposed to an antineutrino beam at Institute of High Energy Physics. The total photographed interior of the chamber was 6.5 cu m, and 55,000 photographs were analyzed. The candidates for deep inelastic interaction $\tilde{\nu}_u + N \rightarrow u^+ + \chi$ were selected on the basis of several criteria. The findings on the y-distribution ($y = \nu / E_{\tilde{\nu}}$, where $\nu = E_h$ = the corrected energy transmitted to the hadrons) were found to be in agreement with the predictions of the elementary quark-parton model, within the 2-25 GeV energy range. The energy dependence of the mean square of the transmitted 4-momentum was found to be $\langle q^2 \rangle = (0.14 \pm 0.12) + (0.13 \pm 0.02)E_{\tilde{\nu}}$. Figures 3; references 6: 2 Russian, 4 Western.
[66-1386]

USSR

FIVE-MINUTE FLUCTUATIONS IN THE INTENSITY OF ATMOSPHERIC HARD GAMMA RADIATION

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 9, 5 Nov 79 pp 631-633 manuscript received 28 Sep 79

GAL'PER, A. M., KIRILLOV-UGRYUMOV, V. G., KUROCHKIN, A. V., LEYKOV, N. F. and LUCHKOV, B. I.

[Abstract] This work is a continuation of an earlier investigation resulting in the detection of quasiperiodic 10-40 min fluctuations in the intensity of gamma radiation in the upper layers of the atmosphere, with the difference that now the volume of the experiments and the investigated frequency range were expanded. Gamma radiation was recorded with the aid of a high-altitude balloon-borne spark-chamber γ-telescope during 5 flights performed between the years 1972 and 1979 at residual-atmosphere altitudes equivalent to 4-10 g/cm^2. The duration of measurements during individual

flights ranged from 5 to 12 hr. The level of fluctuations in gamma radiation was estimated as a function of the integral spectral density J. Averaging of the findings resulted in a reliable isolation of a ~ 5 min period of fluctuations in the intensity of atmospheric γ-quanta (with energies of > 40 MeV); this period also happens to be characteristic of large-scale solar-surface oscillations, which points to a genetic relationship between 5-min fluctuations in the intensity of atmospheric γ-radiation and the processes occurring on the sun. While the mechanism of the transmission of these oscillations from the sun to the earth remains unclear, it is noteworthy that the flight on 5 July 1976, in a period of low solar activity, did not record the presence of fluctuations in γ-radiation. Figure 1; references 10: 5 Russian, 5 Western.
[66-1386]

USSR

A NEW METHOD OF PRODUCING HIGHLY ORIENTED LIGHT BEAMS BY WAVEFRONT REVERSAL

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 8, 20 Oct 79 pp 520-523 manuscript received 8 Sep 79

ANDREYEV, N. F., BESPALOV, V. I., KISELEV, A. M., MATVEYEV, A. Z., PASMANIK, G. A., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] A method of producing optical radiation with a plane wave front without the aid of a reference wave is proposed, as a means of conversion from multimodal to unimodal radiation, namely by summing the frequencies of two multimodal light beams with complex-conjugate fields. The phase of a light beam can be inverted through wavefront reversal during Mandel'shtam-Brillouin stimulated scattering, with only the space-variable part of the phase reversing the sign and the time-variable part of the phase remaining the same. A flat mirror and a Mandel'shtam-Brillouin mirror are needed for compensation of spatial distortions in the wavefront without compensating the phase changes in time. The feasibility of this method was demonstrated in an experiment with a neodymium laser ($\lambda = 1.06 \mu$m), also a diverging lens (F = -1 m), a splitting mirror (R = 0.10) and a doubling crystal ($LiIO_3$). It was found possible to decrease the beam divergence and to increase the spectral brightness, relative to independent doubling of the two beams into which the original beam had been split, without violating the second law of thermodynamics. The authors thank A. V. GAPONOV for discussing the results, YU. K. VEREVKIN for helping with the experiment, and M. S. SANDLER for the stimulating comments on the problem of frequency stabilization by means of complex-conjugate signals. Figures 2; references: 10 Russian.
[64-2415]

USSR

HYPER-RAMAN RESONANT SCATTERING OF LIGHT ON OPTICAL PHONONS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 9, 5 Nov 79 pp 617-620 manuscript received 24 Sep 79

POLIVANOV, YU. N. and SAYAKHOV, R. SH.

[Abstract] The first experimental observation of resonant hyper-Raman scattering (HRS) of light on optical phonons is reported on. The scattering was excited with the aid of a Nd-doped YAG laser ($\lambda_\ell = 1.064 \mu$m), and the scattered light was recorded with the aid of a strobed and cooled

photomultiplier. HRS was observed at an angle of 90° to the propagation direction of the exciting radiation, and isolated with the aid of an MDR-2 monochromator. A CdS crystal was selected as the object of investigation, since then, when a YAG laser is used to excite HRS, the scattering frequency of light lies in a near-resonance region and the resonance conditions can be modified by altering the specimen temperature. Resonant HRS was investigated by measuring the integral intensities of both the Stokes and the anti-Stokes components of the scattering on longitudinal optical phonons with E_1 (ν_{LO} = 307 cm^{-1}) symmetry. Compared with conventional combination scattering of light by CdS crystals, the hyper-Raman resonant scattering of the same crystals displays certain distinctive features. E. g. resonant HRS lines are absent for transverse phonons. Figures 2; references 7: 3 Russian, 4 Western.
[66-1386]

USSR

POSSIBILITY OF SIMULTANEOUS SELF-FOCUSING OF AN ATOM BEAM AND A LIGHT BEAM

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30, No 10, 20 Nov 79 pp 645-647 manuscript received 20 Jul 79 after revision, 12 Oct 79

KLIMONTOVICH, YU. L. and LUZGIN, S. N., Moscow State University imeni M. V. Lomonosov

[Abstract] Coaxial atom and light beams are considered with dipole forces of light pressure acting during the polarization relaxation time. With saturation taken into account, it is theoretically possible for these forces to cause simultaneous self-focusing of the atoms with the minimum electric potential at the axis and the light with the maximum refractive index at the axis. This is demonstrated numerically in the case of sodium vapor and light filling a cylinder, by calculating the atom beam concentration necessary for a self-channeling of the light (angle of diffractive divergence equal to angle of total reflection). Both beams may propagate in the same or in opposite directions, simultaneous self-focusing in the latter case being more likely with a symmetrized distribution of field and atoms.
[65-2415]

USSR UDC 539.376

INVESTIGATION OF STRESS-RUPTURE STRENGTH AND LONGEVITY OF GLASS-PLASTIC COMPOSITES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248, No 3, 1979
pp 565-567 manuscript received 3 Mar 78

ROGINSKIY, S. L. and KANOVICH, M. Z., Kryukovo, Moskovskaya Oblast, All-Union Scientific Research Institute of Glass Plastics and Glass Fibers

[Abstract] The problem of predicting the stress-rupture strength of glass-plastic composites on the basis of known short-time flexural-strength characteristics of the reinforcing filler and binder, rheological constants of the composite, and the deformation limit of the composite, is considered. It is assumed that rupture of the composite occurs under the same limiting strain regardless of the duration of loading. On this basis, a formula for determining the longevity and stress-rupture strength of the composite is derived. The presented solution is of definite interest, since normally stress-rupture strength is evaluated on the basis of costly and laborious years-long experiments. At the same time, however, the findings are not sufficiently universal, being applicable only to the composites in question. References 8: 6 Russian, 2 Western.
[48-1386]

USSR UDC 537.312.62

INFLUENCE THAT THE TRANSVERSE RESISTANCE OF A MULTIPLE-STRAND SUPERCONDUCTIVE WIRE HAS ON ITS CURRENT-VOLTAGE CHARACTERISTIC

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248, No 1, 1979 pp 97-101
manuscript received 4 Jun 79

DOROFEYEV, G. L. and KLIMENKO, YE. YU., Institute of Atomic Energy imeni I. V. Kurchatov, Moscow

[Abstract] Modern superconductive wires for windings frequently use matrices with increased resistance in a technique that involves production of multiple-fiber wires by solid-phase diffusion in an effort to reduce energy dissipation in the wire in a variable magnetic field. Because of the increased transverse resistance of such wires, the cross sectional current distribution remains nonuniform to a considerable distance from a current contact. It is shown in this paper that the exponential nature of the current-voltage characteristic of actual rigid superconductors leads to steps on the current-voltage curves of the wires with a slope and height that depends on the characteristics of normal layers and the superconductor. The analysis is based on the simplest case of a wire with two identical superconductive layers separated by a layer of normal metal with given linear resistance. Expressions are proposed for determining the resistance of transition layers. The initial and final exponential sections of the current-voltage characteristic enable description of the current-carrying capacity of the first superconductive layer and of the wire as a whole. The authors thank N. A. Chernoplekov for interest in the work. Figures 2, references 9: 7 Russian, 2 Western.
[45-6610]

USSR UDC 551.463

A COMPREHENSIVE STUDY OF THE FLUCTUATION THERMOHYDRODYNAMIC CHARACTERISTICS OF SEA WATER

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 37, No 4, Oct 79
pp 589-593 manuscript received 13 Dec 78

BARKOV, YU. D., ISAYEV, S. V., OSTANIN, O. N., KRYLOVICH, V. I., POPOV, V. K., SOLODUKHIN, A. D. and STEPANOV, S. I., Institute of Heat and Mass Exchange imeni A. V. Lykov, Academy of Sciences BSSR, Division of the Physics and Nondestructive Testing, Academy of Sciences BSSR. Belorussian Polytechnical Institute, Minsk

[Abstract] This work was done in cooperation with the Far Eastern Scientific Research Hydrometeorological Institute as part of a comprehensive study of the pulsation characteristics of sea water based on acoustic, optical and thermocontact methods developed at the Institute of Heat and Mass Exchange imeni A. V. Lykov. These techniques are described, and block diagrams are given of the instrumentation used for studying the fluctuation characteristics of temperature, density and the index of refraction of sea water. The practical applicability of the procedures is illustrated by the results of experiments done during the 1976-1977 expedition to the coastal area of the Sea of Japan. Analysis of the results of measurements shows that pulsations in the density of sea water at given depths occur chiefly due to temperature fluctuations. Figures 4; references: 10 Russian. [58-6610]

USSR UDC 536.24.02

TEMPERATURE FIELD OF A ROTATING HOLLOW CYLINDER

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 37, No 4, Oct 79
pp 705-711 manuscript received 30 Jan 79

IGNASHOV, I. A. and BYSTROUMOV, V. A., Vologda Polytechnical Institute

[Abstract] The authors consider an infinitely long cylinder with a radial cross section that is a doubly connected region bounded on the outside and the inside by circles of fixed radius. A certain part of the outer surface of the cylinder is in contact with a strip of hot metal moving translationally at a fixed velocity so that the cylinder rotates about a stationary axis. The cylinder realizes heat perception by contact, convective and radiant heat exchange. At the instant corresponding to time zero of the heat process, a fluid is admitted to the inner channel of the cylinder in

turbulent flow to keep the temperature constant on the inside surface. The initial temperature on the outer surface is established instantaneously, and does not change with time with respect to a coordinate system fixed at the contact point and the axis of the cylinder. The initial temperature in the body of the cylinder is taken as constant. The temperature distribution in the cylinder is found for any elapsed time. The boundary conditions and heat conduction equations are given in Euler variables, which yields a solution in the physical sense of temperature (a real scalar function). A transition to Lagrange variables (change in temperature of a fixed material fiber) is realized by the appropriate substitution of variables. Figures 2, references: 5 Russian.
[58-6610]

USSR UDC 536.3

A NUMERICAL METHOD OF REFINED CALCULATION OF RE-RADIATION AND SCATTERING IN PROCESSES OF RADIATIVE HEAT EXCHANGE

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 37, No 4, Oct 79 p 751
manuscript received 13 Feb 79, abstract received 25 Apr 79

ZHURAVLEV, YU. A.

[Abstract of deposited article, All-Union Institute of Scientific and Technical Information, No 2099 Dep.]

[Abstract] An examination is made of problems of calculating the resolving geometrical optics characteristics of radiation with regard to the error of the relative values of re-radiated and scattered energy under optically homogeneous and optically nonhomogeneous conditions. An approximate system of linear algebraic equations is derived that provides the required accuracy of determination of the re-radiated and scattered part of the radiation. Another system of algebraic equations is proposed for direct calculation of re-radiation and scattering in multizonal systems.
[58-6610]

USSR UDC 537.525.1

A THERMOCOUPLE IN A NONEQUILIBRIUM PLASMA

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 4, Jul-Aug 79 pp 828-834 manuscript received 10 Jul 78

IVANOV, YU. A., LEBEDEV, YU. A. and TROFIMOV, V. N., Institute of Petrochemical Synthesis, USSR Academy of Sciences

[Abstract] The nature of perturbation of a plasma resulting from introduction of a thermocouple into it for measurements is considered. The following factors are taken into account: change of the radial distribution of heat sources; heat removal by the probe; removal of charged particles by the probe; removal of excited particles by the probe; chemical reactions on the probe surface; disturbance of electric field structure by the probe. Calculations were made for a nonequilibrium plasma from the positive column of a sticking DC current discharge in the diffusion mode; Schottky's approximate theory of the positive column was used. First the radial distribution of electrons was found for different ratios of the discharge tube radius to the probe radius (probe inserted coaxially), after which the radial distribution of gas temperature was determined. A graph of the results is presented for different radius ratios. A more accurate method of determining plasma parameters is the use of two thermocouples of different diameters. An experiment was carried out using thermocouples of diameters 0.065 and 0.03 cm in a glass tube 30 mm in diameter containing nitrogen at a pressure of 1.6 mm Hg and with a discharge current of 0.01-0.075 A. A table of experimental results is presented. Thanks are expressed to D. I. Slovetskiy and A. D. Urbas for experimental data and advice. Figures 4; references 12: 6 Russian, 6 Western.
[187-8480]

USSR UDC 536.24

APPROXIMATE CALCULATION OF WALL TEMPERATURE DURING TURBULENT HEAT EXCHANGE IN A CIRCULAR TUBE WITH THERMAL BOUNDARY CONDITIONS VARIABLE OVER THE PERIMETER

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 4, Jul-Aug 79 p 878 received 19 Dec 77 (No 1383-79, Dep. 19 Apr 79, VINITI)

KHRABENSKIY, V. B., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The hypothesis of the universality of dimensionless temperature profiles of a coolant normal to the perimeter of a channel is used to derive a simple approximate analytical formula for calculating heat exchange

in turbulent flow of a coolant in a circular tube with heat flux nonuniformly distributed over the outer perimeter. The distribution of the heat transfer coefficient and the interior wall temperature along the perimeter of the tube can be determined by the use of the formula. The method gave good results when compared with both experimental data and calculation results from a more complex method. References: 1 Russian.
[187-8480]

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